Virtual Discrete Mathematics Day at Albany, April 25-26, 2020
Northeast Combinatorics Network
https://sites.google.com/view/northeastcombinatoricsnetwork/home
Speakers, Titles and Abstracts

- (Sat. 9:00AM) **Megan Owen** (CUNY, Lehman College) http://comet.lehman.cuny.edu/owen/
  Representations of partial leaf sets in phylogenetic tree space

  Abstract: A phylogenetic tree depicts evolutionary relationships between sets of organisms. Billera, Holmes, and Vogtmann defined a metric space of phylogenetic trees (BHV treespace) to provide a natural geometric setting for describing collections of trees with the same set of leaves (ie. for the same set of organisms). However, sometimes biologists want to analyze collections of trees on overlapping, but non-identical, leaf sets. We refine and adapt a combinatorial algorithm of Ren et al. to work for metric trees to give a full characterization of the subspace of extensions of a subtree. We describe how to apply our algorithm to define and search a space of possible trees on all leaves and, for a collection of trees with different leaf sets, to measure their compatibility. I will end this talk with some open problems.
  This talk is based on joint work with Gillian Grindstaff.

  https://nextstrain.org Pathogen evolution website.

- (Sat. 10:30AM) **Francois Bergeron** (Univ. of Quebec at Montreal) http://bergeron.math.uqam.ca/
  Recent advances in the study of multivariate diagonal harmonics

  Abstract: Over the last 25 years, the study of $GL_2 \times S_n$-modules of diagonal harmonic polynomials has seen many interesting developments; on top of having been shown to relate to several fields of mathematics (algebraic combinatorics, representation theory, algebraic geometry, knot theory) and theoretical physics (conformal field theory, statistical physics). Its extension to several sets of variables makes it possible to give a new understanding to links between many questions of the subject. We will present recent results and conjectures for the corresponding $GL_\infty \times S_n$-modules, including ties with the Delta-conjecture, representation theoretic models for the effect of the nabla "Macdonald eigenoperator" on hook indexed Schur functions, as well as explicit descriptions of some components of the $GL_\infty \times S_n$-modules. We will also discuss some of the ties with closely related combinatorial questions, which include rectangular Catalan combinatorics, enumeration of chains in the Tamari poset, and the sweep map.

- (Sat. 1:00PM) **Alejandro Morales** (UMass Amherst) https://sites.google.com/view/ahmorales/
  Volumes and triangulations of flow polytopes of graphs

  Abstract: A flow polytope of a directed acyclic graph is the set of flows on the edges of the graph with prescribed netflows on vertices. Flow polytopes of graphs are a rich family of polytopes that includes polytopes of interest in probability, optimization, representation theory, and algebraic combinatorics. These polytopes are related to partially ordered sets when the graphs are planar and special cases have remarkable formulas for their volumes and lattice points due to Baldoni-Vergne and Postnikov-Stanley. I will talk about recent results on these polytopes including a relation between seemingly different triangulations by Postnkov-Stanley and Danilov-Karzanov-Koshevoy. This talk is based on joint work with Mészáros and Striker.

  https://people.math.umass.edu/~ahmorales/talks/DMD.pdf SLIDES

- (Sun. 9:30AM) **Jessica Sidman** (Mount Holyoke) https://www.mtholyoke.edu/~jsidman
  Geometric Equations for Matroid Varieties

  Abstract: Let x denote a k-dimensional subspace of $\mathbb{C}^n$ and let A_x be a $k \times n$ matrix whose rows are a basis for x. The matroid M_x on the columns of A_x is invariant under a change of basis for x. What can we say about the set Γ_x of all $k$dimensional subspaces y such that $M_y = M_x$? We will explore this question algebraically, showing that for some matroids that arise geometrically, many non-trivial equations vanishing on Γ_x can be derived using geometry. This work is joint with Will Traves and Ashley Wheeler.

- (Sun. 4:15AM) **Sophie Spirkl** (Princeton)https://sites.google.com/site/sophiespirkl
  Excluding induced subgraphs from sparse graphs

  Abstract: Let us call two sets A and B of vertices in a graph G a "pure pair" if either all or no edges between the two sets are present in G. Random graphs are unlikely to have pure pairs with both A and B large. This changes when excluding induced subgraphs. I'll present recent progress on the question of how large a pure pair we can guarantee in different settings. Joint work with Maria Chudnovsky, Jacob Fox, Alex Scott, and Paul Seymour.